
Space Weather Technical Forecast

Issued on Sunday, 16 April 2023 at 00:24 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of M-class flares (R1-R2 Minor-Moderate radio blackouts), slight chance of X-Class flares (R3 strong radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, but with persistent C-class activity observed from regions across the visible disk. There are 11 active regions currently with four prominent regions. AR3282 (Eki, Beta-Gamma) has developed rapidly over the last 24 hours, with a delta spot briefly developing. AR3280 (Esi, Beta-Gamma) is also complex but after some marked changes appears to have stabilised somewhat. AR3281 (Eki, beta-Gamma) continues to reveal increasing complexity as it rotates onto the visible disc. AR3279 (Csi, Beta-Gamma) and AR3272 (Bxo, Beta) are both weakening having been previously notable regions. The remaining regions are all simple or developing. Imagery from a CME which left the southwest quadrant from the region of AR3272 during 14 April remains under investigation, and will be analysed should sufficient data becomes available. A large filament liftoff observed in the northern hemisphere approximately 15/1100UTC has been analysed and we await model data, with the potential for a glancing blow late in the period. We await imagery for two other CMEs observed in the far southwest and northwest quadrant late on the 15 April.

Solar Wind / Geomagnetic Activity: The solar wind observed at L1 has generally been slow-ambient, below 400km/s, but showed a small but distinct increase midway through the period. This increase correlated with an increase in the density from around average values to close to above average values, reaching 10ppcc at 15/1024UTC. This could be a weak high speed stream connection, with data continuing to be monitored. Total magnetic field strength, IMF, has been weak throughout, below 8nT, with the north-south component also varying weakly between +5/-5nT. The phi angle was resolutely positive (away from the Sun) until 15/1800UTC when it became weakly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) as measured at GOES16, was at background levels. High energy electron flux (greater than 2MeV) as measured at GOES16 was at background levels. The associated 24-hour integrated electron fluence was well below the Active threshold on a steady trend, with 1.28e6 integrated pfu observed at 16/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be remain generally Low or Moderate through the next four days, with isolated to occasional M-class flares (R1-R2 Minor-Moderate radio blackouts) likely given the number of complicated and developing active region. There is also a slight chance of isolated X-class flares (R3 Strong radio blackouts).

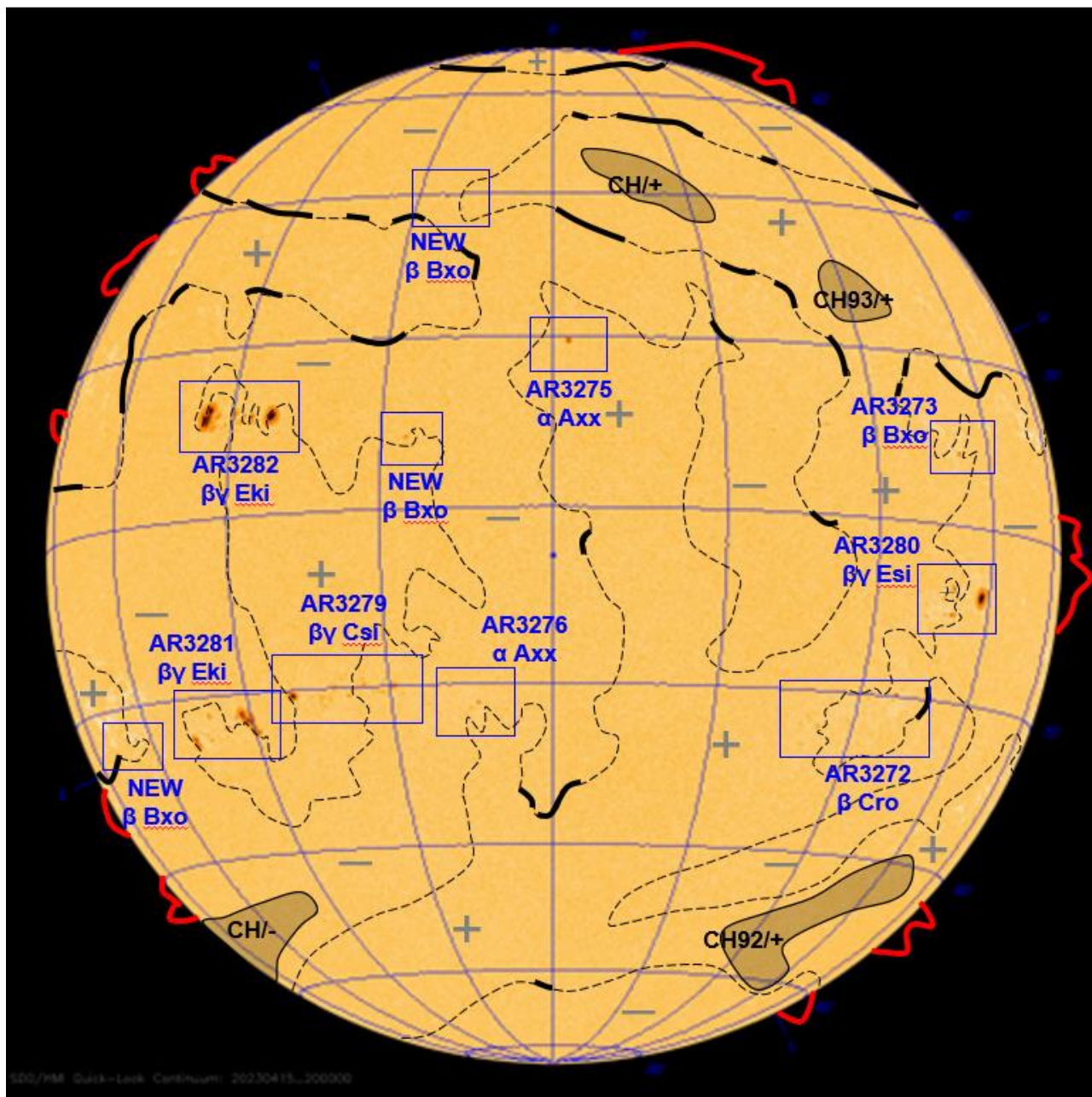
Solar Wind / Geomagnetic Activity: A CME which left the Sun on 12 April may glance the Earth on 16 April, but with low confidence. Earth is expected to experience generally Slow-Ambient background solar wind conditions, though some slight transient enhancement possible

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

from glancing coronal hole influence. Geomagnetic activity is expected to remain Quiet to Unsettled, with a chance of Active and a slight chance of G1/Minor Storms on day 1 (16 Apr) due to the possible CME glance.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to persist at background levels, although there is a slight chance of a greater than S1 event as some of the more complex active regions transit towards the western solar hemisphere. High energy (greater than 2 MeV) electron flux is currently at background levels, and is considered most likely to remain so in the absence of any high confidence fast wind enhancements. The associated 24-hour integrated fluence is expected to remain below the Active threshold ($1e8$ integrated pfu).

Figure 1. Solar Analysis Valid 15/2000 UTC.



Key: Filament ---, Prominence ---, Magnetic Field Line ---, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - $\beta\gamma$ - $\beta\gamma\delta$ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

A CME which left the southwest of the Sun on 12 April forecast to potentially glance the Earth on 16 April, but with a low confidence. Imagery from a further CME which left the southwest quadrant from the region of AR3272 during 14 April remains under investigation, and will be analysed should sufficient data becomes available. A large filament liftoff observed in the northern hemisphere on the 15 April has been analysed and we await model data, with the potential for a glancing blow late in the period. We await imagery for two other CME observed in the far southwest and northwest quadrant late on the 15 April.

Outside of any CME influence Earth is expected to experience generally Slow-Ambient background conditions. Some transient enhancement is possible, particularly early in the period from several positive coronal holes in both the northern and southern hemisphere. Based on their positions the majority of the effects of these features expected to pass to the south and north of the Earth respectively. Significant differences between current and previous rotation mean that persistence and MOSWOC SWPM model unlikely to provide a useful guide to solar wind speeds during the period.

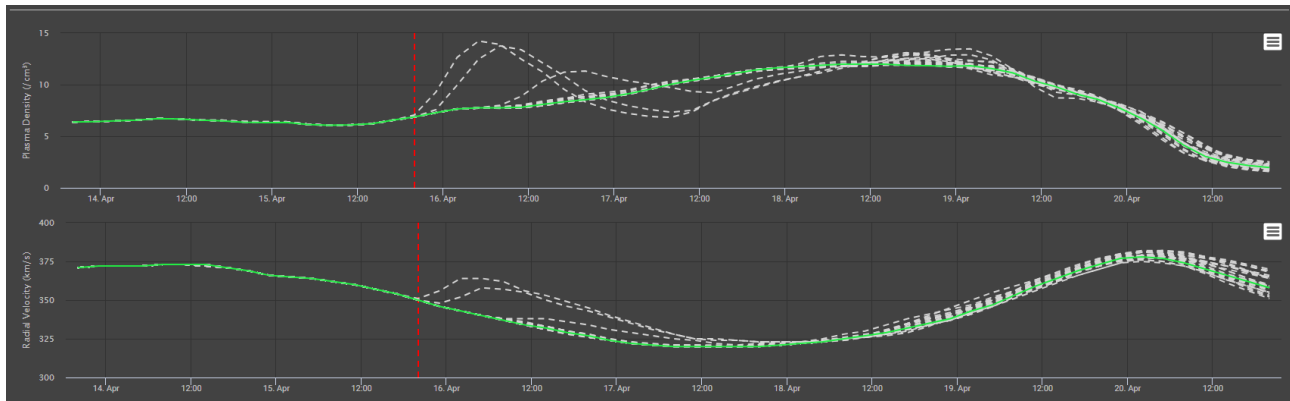
Geomagnetic activity is forecast to be mainly Quiet to Unsettled, with a chance of Active and a very slight chance of G1/Minor Storms during days 1, 2 and 3 (16-17 and 19 Apr) due to the potential for glancing CME effects.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	5	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
12/0959	Partial Halo	Filament Eruption	SW	550km/s	16/0900UTC	Low confidence glancing effect

Figure 2: Latest MOSWOC ENLIL Ensemble output, showing CME interaction in a minority of members on the 16th.





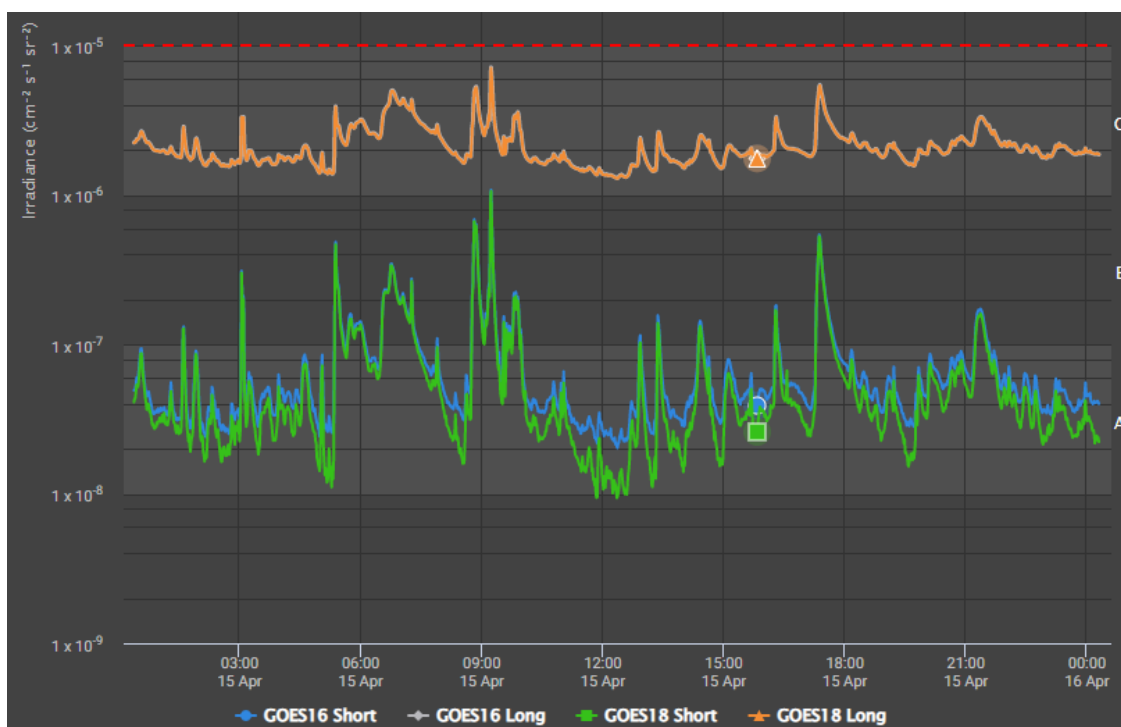
Radio Blackouts - X-Ray Flares:

There are 11 active regions currently on the visible disc with four prominent regions. AR3282 has developed rapidly over the last 24 hours, with a delta spot briefly developing, which has now faded. AR3280 is also complex and after some marked changes appears to have stabilised somewhat. AR3281 continues to reveal increasing complexity as it rotates onto the visible disc. AR3279 and AR3272 are both weakening having been previously notable regions. The remaining regions are all simple or developing, including three unnumbered regions, one in the far north and one in the south of the northeast quadrant and one close to the southeast limb.

Solar activity is expected to be remain generally Low or Moderate through the next four days, with isolated to occasional M-class flares likely given the number of complicated and developing active region. There is also a slight chance of isolated X-class flares which is maintained though the period pending further developments.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	60	60	60	60
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3: 24hr X-ray flux from GOES 18



Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES16, is most likely to remain at background levels through the period.

AR3280 carries the greatest risk of a proton event early in the period, with a continued high level of magnetic complexity as it rotates across the western hemisphere. A number of regions in the east could produce some proton response from particularly energetic events, with these acting to maintain the risk into the period as they rotate westward.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	10	10	10
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)



High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy electron flux (greater than 2MeV) is at background levels and is likely to remain muted in a benign solar wind environment with no significant high speed stream effects expected. The British Antarctic Survey radiation Belt Model (BAS-RBM) is forecasting a similarly muted environment, with good verification from the last four days. Any inputs from CME effects may have a neutral effect in the short term, considering the balance between an increase in any geomagnetic activity and input of material into the radiation belts.

The associated electron fluence forecast is well below the Active ($1\text{e}8$ integrated pfu) threshold and is expected to remain so during the forecast period. MOSWOC REFM is forecasting a slightly rising trend in fluence for the next four days, viewed as good guidance.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	5	5
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 4: Latest MOSWOC REFM model output

